



**WPAFB RADIATION SAFETY OFFICE
SHIPMENT QUALITY ASSURANCE CHECKLIST**



August 2001

Date: _____ **Shipper:** _____ **Destination:** _____

Item Description	Radionuclide	Activity Each	Number of Items	Total Activity

Radiation Package Survey Results: surface _____ mrem/hr 1 meter _____ mrem/hr

Instrument Used: Mfgr: _____ Model: _____ S/N: _____ Cal Date: _____

Person Completing Checklist: _____ **Signature:** _____

EXCEPTED PACKAGE SHIPMENT

Yes **No** **N/A**

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | 1. Package meets general design requirements (see definitions). |
| <input type="checkbox"/> | <input type="checkbox"/> | 2. Package contains less than 15 grams of U-235. |
| <input type="checkbox"/> | <input type="checkbox"/> | 3. Activity less than §173.425, Table 7 (A ₁ /A ₂ Quantity Limits are found in §173.435). Shipment as:
a. Limited Quantity: Permissible package limit: _____ Actual package activity: _____
b. Instrument or Article: Permissible package limit: _____ Actual package activity: _____
Permissible maximum article activity: _____ Actual maximum article activity: _____ |
| <input type="checkbox"/> | <input type="checkbox"/> | 4. Radiation level at any point on the external surface of package less than or equal to 0.5 mrem/hr. |
| <input type="checkbox"/> | <input type="checkbox"/> | 5. Removable surface contamination less than 2.2 dpm/cm ² (alpha) or 22 dpm/cm ² (beta/gamma). |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. Notice enclosed in or on the package includes name of consignor or consignee and one of the following, as appropriate: |

SELECT APPROPRIATE ONE (ONLY ONE):

- ☐ a. "This package conforms to the conditions and limitations specified in 49CFR 173.421 for radioactive material, excepted package - limited quantity of material, UN2910";
- ☐ b. "This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package - instruments or articles UN2910"; or

- | | | | |
|--------------------------|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. For LIMITED QUANTITY ONLY, outside of the inner package or outside of package itself bears the marking "Radioactive". |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. For INSTRUMENTS AND ARTICLES ONLY, the radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article does not exceed 10 mrem/hr. |

IMPORTANT: If you checked "no" to any item above, contact WPAFB Radiation Safety Office for further instruction.

COMMENTS:

ACTIVITY LIMITS
INSTRUMENTS & ARTICLES and LIMITED QUANTITY
(49 CFR 173.425)

Radionuclide	NORMAL FORM			SPECIAL FORM		
	Instrument & Articles		Limited Quantity	Instrument & Articles		Limited Quantity
	Instrument Limit	Package Limit		Instrument Limit	Package Limit	
Americium 241	54.1 µCi	5.41 mCi	5.41 µCi	541 mCi	54.1 Ci	54.1 mCi
Cadmium 109	270 mCi	27 Ci	27 mCi	10.8 Ci	1080 Ci	1.08 Ci
Cobalt 57	2.16 Ci	216 Ci	216 mCi	2.16 Ci	216 Ci	216 mCi
Cobalt 60	108 mCi	10.8 Ci	10.8 mCi	108 mCi	10.8 Ci	10.8 mCi
Chromium 51	8.11 Ci	811 Ci	811 mCi	8.11 Ci	811 Ci	811 mCi
Cesium 137	135 mCi	13.5 Ci	13.5 mCi	541 mCi	54.1 Ci	54.1 mCi
Iodine 125	541 mCi	54.1 Ci	54.1 mCi	5.41 Ci	541 Ci	541 mCi
Iron 55	10.8 Ci	1080 Ci	1.08 Ci	10.8 Ci	1080 Ci	1.08 Ci
Krypton 85	270 mCi	2.7 Ci	270 mCi	541 mCi	5.41 Ci	541 mCi
Nickel 63	8.11 Ci	811 Ci	811 mCi	10.8 Ci	1080 Ci	1.08 Ci
Plutonium 239	54.1 µCi	5.41 mCi	5.41 µCi	541 mCi	54.1 Ci	54.1 mCi
Polonium 210	5.41 mCi	541 mCi	541 µCi	10.8 Ci	1080 Ci	1.08 Ci
Promethium 147	243 mCi	24.3 Ci	24.3 mCi	10.8 Ci	1080 Ci	1.08 Ci
Radium 226	5.41 mCi	541 mCi	541 µCi	81.1 Ci	8.11 Ci	8.11 Ci
Tritium [†]	21.6 Ci	216 Ci	21.6 Ci	n/a	n/a	n/a

NOTES:

[†] These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

DEFINITIONS

General Design Requirements:

1. Easily handled and secured in or on conveyance.
2. If lifting attachment, designed with safety factor.
3. External surfaces free from protruding features and easily deconned.
4. Outer layer will avoid water collection.
5. Each feature added does not reduce safety of package.
6. Withstands conditions of normal transport including closing devices.
7. Materials physically and chemically compatible.
8. Values protected against unauthorized operation
9. For transport by air – a) temp. of surface will not exceed 50°C with ambient temp at 38°C, b) integrity maintained if ambient temp. at – 40°C to 55°C, and c) liquids will not leak at pressure differential of not less than 95 kPa (13.8 lb/in²).

Instrument and article: Any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article have Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.

Normal form: Radioactive material, which has not been demonstrated to qualify as “special form radioactive material.”

Special form: Radioactive material which satisfies: 1) single solid piece or in a sealed capsule that can only be opened by destroying capsule; 2) piece or capsule has at least one dimension not less than 5 mm; and 3) it satisfies test requirements of 49 CFR 173.469.

PACKAGE RADIATION LEVEL LIMITS
(49 CFR 173.421, 173.424)

LIMITED QUANTITY: ≤ 0.005 mSv/hr (0.5 mrem/hr) on any surface.

INSTRUMENTS & ARTICLES = ≤ 0.005 mSv/hr (0.5 mrem/hr) on any surface and ≤ 0.1 mSv/hr (10 mrem/hr) at 10 cm (4 inches) from external surface of instrument.

**NON-FIXED EXTERNAL RADIOACTIVE
CONTAMINATION-WIPE LIMITS**
(Averaged over 300 cm²)
(49 CFR 173.443)

Contaminant	Maximum permissible limits		
	Bq/cm ²	µCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁶	2.2

Swipe Evaluation (ADM-300):

$$\frac{Bq}{cm^2} = \frac{cpm (net)}{0.5 \times E_c \times 60 \frac{sec}{min} \times A (cm^2)}$$

E_c = Probe Efficiency (AP-100 = 0.3 for ²³⁹Pu; BP-100 = 0.45 for ⁹⁰Sr)

A = Area Swiped (300 cm²)

0.5 = 2 P to 4 P geometry conversion

cpm_(net) = Background subtracted from gross count

1 Bq = 1 dps or 60 dpm

$$\frac{Bq}{cm^2} = \frac{100 cpm}{0.5 \times 0.3 \times 60 \frac{sec}{min} \times 300 cm^2} = \frac{100}{2700} = 0.037 \frac{Bq}{cm^2}$$

EXAMPLE:

$$0.037 \frac{Bq}{cm^2} \times 60 \frac{dpm}{Bq} = 2.22 \frac{dpm}{cm^2}$$